

In-vitro simulation of AOM mediated diagenesis in cold-water coral carbonate mounds

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Anaerobic oxidation of methane (AOM) mediated by a consortium of archaea and bacteria is known from many modern marine sediments. Besides the process of AOM, the formation of authigenic carbonate phases, i.e. dolomite, aragonite and high-Mg calcite, is provoking early stage diagenesis. The aim of this research is to study this process – AOM and formation of early diagenetic carbonates – in Sub-Recent to Recent cold-water coral (CWC) carbonate mounds. Usually, CWC carbonate mounds are carbonate build-ups on the continental slope at intermediate water depth (below the photic zone), composed by framework builders (cold-water corals), pelagic ooze and detrital material. AOM in CWC carbonate mounds is thought to alter the primary environmental record at an early stage. CWC carbonate mounds in the Gulf of Cadiz offer a unique opportunity to study feedback mechanisms between biogeochemical processes and primary mound growth phases. To understand how AOM activity and its associated early diagenesis vary spatially and temporarily through a mound structure and how it affects its petrophysical character, we studied three gravity cores originating from CWC carbonate mounds on the Pen Duick Escarpment in the Gulf of Cadiz, Morocco. A detailed analysis of lipid biomarker content and isotopic composition reveals a record of past and present AOM activity along the core. Parallel to this field approach, the major focus of the study is to subject carbonate mound sediments originating from the Gulf of Cadiz to an environment representative for CWC carbonate mound systems under defined laboratory conditions. This will be done by means of an in-house designed sediment-flow-through-system. Artificial seawater enriched in methane gas will flow continuously through cells of sediment. The sediment will be incubated for AOM and sulfate reduction (SR). Over time the cells will be visualized in 3D for changes in mineralogy, porosity and permeability by means of multi-scaled nanotomography to assess the nature of early diagenetic processes in response to AOM activity. Microbial activity will be assessed by monitoring methane and sulfate consumption, quantification of living cells of methane consuming archaea and sulfate reducing bacteria (SRB) and lipid biomarker analysis.